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UNIVERSALIZATION OF THE INTELLIGENCE DEFINITION PROBLEM

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Abstract. The main problem today in the research and development of AI is the lack of a scientific definition of Intelligence, since it is impossible to do something incomprehensible. This fundamentally delegitimizes all developments in this area and science as a whole as a product of exclusively intellectual activity, and any scientific use of the term «Intelligence» in its strict sense is unreasonable. In this paper, this problem is solved by transition to a more general universal paradigm of cognition, which allowed us to deduce the desired definition and universal formalism of Intelligence in its strong sense. Unlike previous publications, the ontology and properties of Intelligence are specified here as necessary components of Intelligence, which are subject to subsequent concretization and materialization in different niches of existence. The results of the work are of both fundamental and applied general scientific importance for all technical and humanitarian applications of Intelligence.

Keywords: Intelligence, universalization, meta-definition; meta-formalization; Universal Theory, the Universe

УНІВЕРСАЛІЗАЦІЯ ПРОБЛЕМИ НАУКОВОГО ВИЗНАЧЕННЯ ІНТЕЛЕКТУ

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Анотація. Головною проблемою сьогодні в дослідженнях та розробках штучного інтелекту є відсутність наукового визначення інтелекту, оскільки неможливо зробити те, що незрозуміло. Це принципово делегітимізує усі разробки у цій галузі й науку в целому як продукт виключно интелектуальної діяльності, а наукове використання термину «Інтелект» в його суворому змісті являється необгрунтованим. У цій роботі ця проблема вирішується засобами переходу на більш загальну універсальну парадигму пізнання, яка дозволить визначити пошукове визначення та універсальний формалізм Інтелекту в його сильному розумінні. На відміну від попередніх публікацій, тут уточнено підстави та властивості Інтелекту як необхідні компоненти, які належать наступній конкретизації та матеріалізації у різних прогалинах існування. Результати роботи мають як фундаментальне, так і прикладне загальнонаукове значення для всіх технічних і гуманітарних прикладок Інтелекту.

Ключові слова: Інтелект, універсалізація, мета-визначення, мета-формалізація, Універсальна теорія, Всесвіт.

Introduction

In spite of immense efforts, contemporary science cannot provide a formal definition of Intelligence, which delegitimizes any research in this area and science in general as a product of exclusively intellectual activity. Moreover, any scientific use of the term «Intelligence» in the strict sense is groundless [1-3].

That condition has not changed since the pioneering 1956 Dartmouth Workshop. In 2007, J. McCarthy pointed out: «The problem is that we cannot yet characterize in general what kinds of computational procedures we want to call intelligent. We understand some of the mechanisms of intelligence and not others. Intelligence is the computational part of the ability to achieve goals in the world». [4].

As a result, in the 1980s the compromise philosophical hypothesis proposed by J. Searle on the fundamental unity of any Intelligence made it possible to distinguish two different types of AI: 1) weak (private, machine) AI that can already be formalized and implemented, and which performs separate intellectual functions, and 2) strong (general, natural) AI equivalent to human intelligence, the formalization (understanding) of which is postponed for the future [5].

Nevertheless, such a division did not eliminate, but only shifted the indicated uncertainty to the problem of identifying mental functions in the diversity of actions of living organisms. The McCarthy-Searl paradigm has advanced, but did not legalize previously mentioned works. A human remained an informal general scientific standard of Intelligence according to the famous Turing test [6].

Problem Statement

It goes without saying that the problem of scientific definition and formalization of the Intelligence is a consequence of the fundamental disadvantages of contemporary science. It can only be solved through a sensible development of the general scientific paradigm [7]. For the first time, the authors done it by means of increasing the level of knowledge abstraction and the transition from the contemporary system of private Universal axioms (in broader terms - dogmas), producing limited concept systems in the corresponding fields, to a sole initial Universal Axiom (Dogma, UA), producing the entire system of concepts of the Universe (UAP) as the constant Universal (Meta-) Formalism (UMF) [8-13]. The particular conceptual areas describe solely simple phenomena that fully belong to one area while the UMF is obliged to describe all phenomena, even the most complex ones, which are the Universe and its Intelligence (Fig.1).

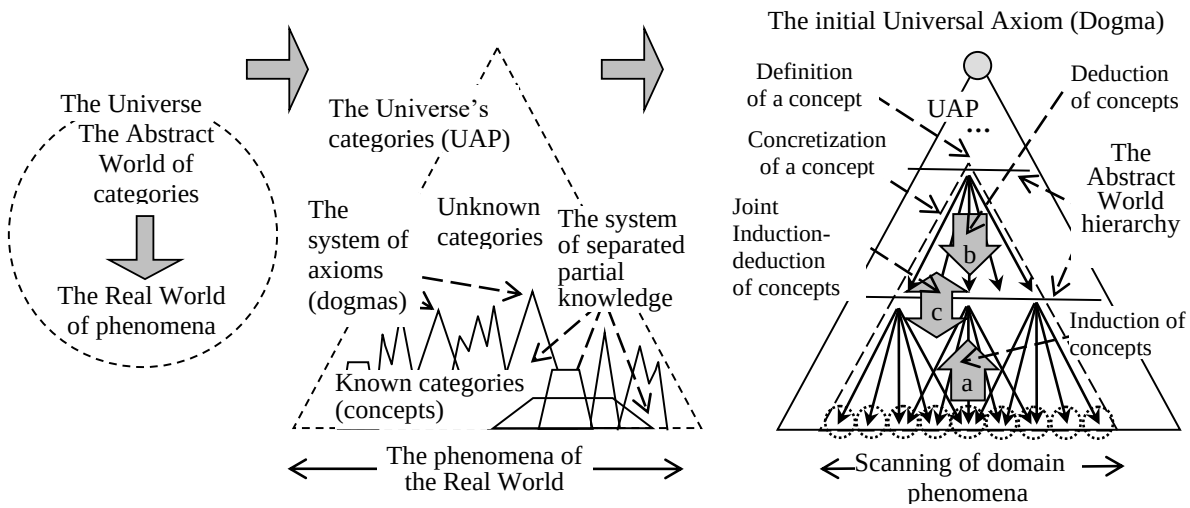

Fig. 1. The development of the world science scheme from Plato and Aristotle through dogmatization to universalization of knowledge

Research Objectives

The authors succeed at 1) proving the possibility of obtaining UMF, 2) creating the foundations of its structure and 3) deducing the (Meta-) Formalism of Intelligence (UMFI) from it, 4) universal for the entire natural world. The UMFI made it clear that Intelligence 5) comes from the highest meta-concepts of the Universe 6) directly from the UA 7) together with the Universe 8) as its most important attribute and 9) merges both of these

concepts, 10) expanding the base of joint research.

Universalization contributes to the radical development of the general scientific cognitive paradigm. A particular axiomatic paradigm is based on the triad «Observation - Hypothesis - Verification experiment» and is restricted to the observed phenomena, while the Universal paradigm is based on the tetrad «Obtaining some Universal Formalism (UF) - Identification of a phenomenon in the Universe - Identification of a phenomenon in the UF - Derivation of a formalism from the UF», which is limited to the UF that is able to exceed the visibility scope (Fig. 2).

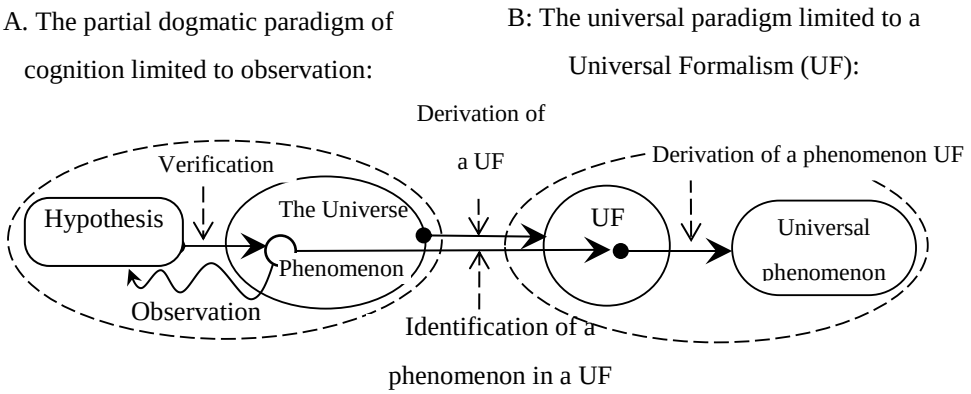

Fig. 2. The schemes of dogmatic (A) and universal (B) paradigms of cognition

The UF is a new scientific concept and its construction is problematic, however it is simplified by the hypothetical homotropy and constancy of the categories of the Universe, allowing the accumulation of copies to form a sole externally stable (with the Universe) and internally (among themselves) consistent system of concepts, which can be tested practically. Needless to say, the UF should be one of a kind, since that is the way our Universe is. The alternative attempts to create it will lead to a single outcome.

Consequently, it was possible to form the UF and deduce UMFI from it, which is consistently coinciding and expanding the observed properties of the Intelligence as its new cognition. The UMFI becomes a new standard of Intelligence, allowing for a deeper formal study of the origin, attributes and classifications of the latter. Substantiation of the Intelligence concept conclusion is the aim of this work.

Original Ontology of Intelligence

Intelligence originates from the relation, which possesses features of the axiom and is accepted as UA (Fig. 3). Therefore, Universe's entities supposedly have a structural nature and are sensibly represented exceptionally by set-theoretic and ER-formalisms.

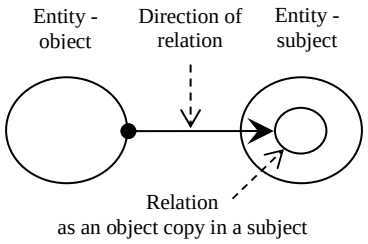

Fig. 3. The scheme of a meta-concept relation

Definition. A relation is a copy of a certain entity (object) in another entity (subject).

Definition. An entity is a part of the Universe distinguished by a particular relation as a whole.

Definition. The Universe is a complete set of directly or indirectly related entities.

Consequence. The Universe and its entities are of the structural nature that is infinitely large, wide and deep.

Consequence. The Universe is its entity.

Consequence. The Universe is a self-determined entity.

Definition. Knowledge is a copy of an entity.

Definition. Cognition is the establishment of relations with entities.

Consequence. Cognition of the Universe is the establishment of relations by its entities with it as a whole.

Consequence. The Universe is a mutual cognition of its entities.

An elementary combination of relations results in the original ontology of cognition.

The advancement of an object copy generates 4 stages of cyclical cognition of the subject: 1) at the border of the subject (information), 2) inside the subject (knowledge), 3) correspondence of the copy with other knowledge of the subject (understanding), 4) cognition of an object (research) (Fig. 4).

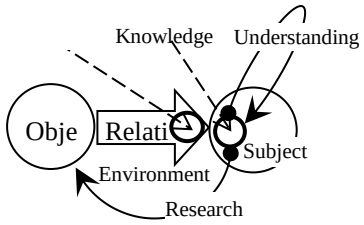

Fig. 4. The scheme of meta-concept cognition

Cognition of multiple objects gives rise to the scheme in Fig. 5.

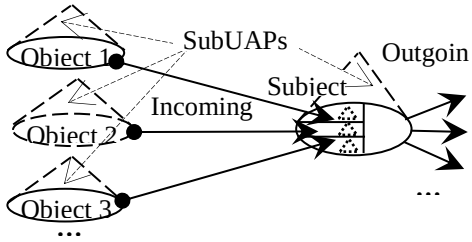

Fig. 5. The scheme of mutual meta-concept cognition

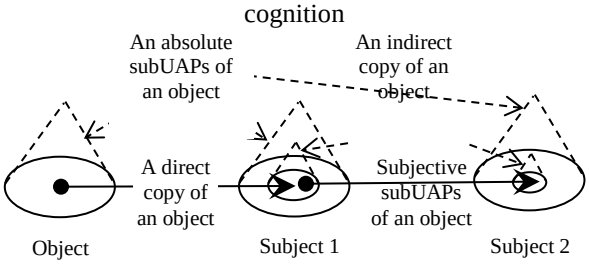

Fig. 6. The scheme of meta-concept teaching

Transferring a copy of an object through an intermediate subject is learning (Fig. 6).

Virtualization of an object copy within a subject (virtualizer) is the excess of object categories on their copies (Fig. 7).

Abstract/real dichotomy of the Universe

According to Plato and Aristotle, the Universe is divided into the World of categories (Abstract World (AW)) and the World of phenomena (Real World (RW)), which is represented by means of a diagram (Fig. 1) according to the modern concept.

According to universal concepts, AW begins in UA and develops further into a pyramid-like system of categories (abstracts, concepts), built into RW in the shape of Space-Time-Matter Complex (STM-Complex), consisting of interrelated Complexes of Space, Time and Matter, the initial properties of which are widely understood (Fig. 8).

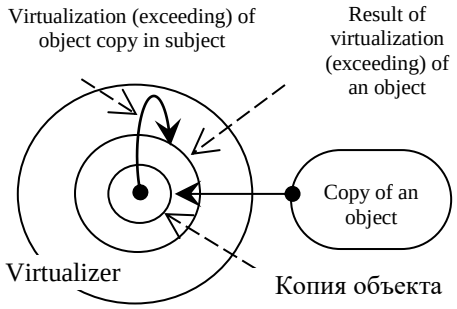

Fig. 7. The scheme of meta-concept virtualization

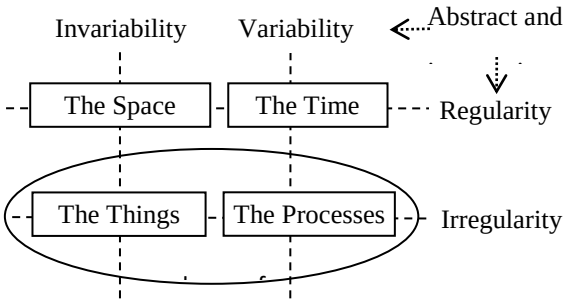

Fig. 8. The scheme of the Complexes ontology

Definition. A phenomenon is an entity of the RW.

Definition. A Complex is a phenomenon that is present in all the RW phenomena.

Definition. Space is a regular and invariable Complex of the RW.

Definition. Time is a regular and variable Complex of the RW.

Definition. Matter is an irregular Complex of the RW.

Definition. A thing is an invariable part of the Matter Complex.

Definition. A process is a variable part of the Matter Complex.

RW (STM-Complex) consists of interrelated phenomena with built-in categories that determine their properties. The existence of phenomena is determined solely by its categories. Presumably, the categories of phenomena do not have internal contradictions. The nature of category carriers is uncertain. However, it does not hinder the initial formalization.

Consequence. Concepts are cognition of the abstract part (categories) of phenomena.

Consequence. Facts are cognition of the real part of phenomena.

Consequence. Due to indirect actions (through other categories), the categories are poorly recognized by phenomena.

Consequence. Due to the direct action, phenomena are strongly cognized by phenomena.

Hypothesis. The system of categories is the same throughout the (infinite) Universe.

Consequence. Facts determine the activated categories of phenomena.

Consequence. Knowledge is the concepts of facts and categories of phenomena.

Definition. A formula (formalism) is the system of categories/concepts of an entity.

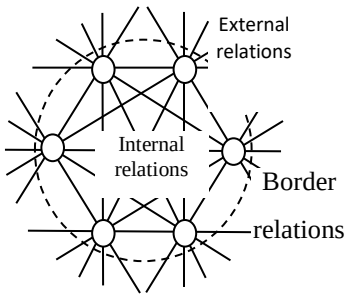

Fig. 9. The scheme of a phenomena harmonic structure

Definition. An axiom (definition) is original formula of an entity.

Universal Harmonic Classification of Phenomen

Phenomena 1) exist in STM-Complex and 2) are divided into 3 non-empty groups of relations: internal, external and intermediate among them (Fig. 9). Additionally, these relations are divided into the Past, Present and Future (Fig. 10).

Special conditions of internal relations development give rise to a universal harmonic classification of phenomena, the simplest of which is shown in Table 1.

Definition. Real relation is the relation in Present.

Definition. A virtual relation is a relation copy.

Consequence. All relations have a virtual part.

1. Class 1 (Thermodynamics) has relatively weak real mutual relations and exists exclusively at the point of the Present, continuously moving from the Past to the Future.

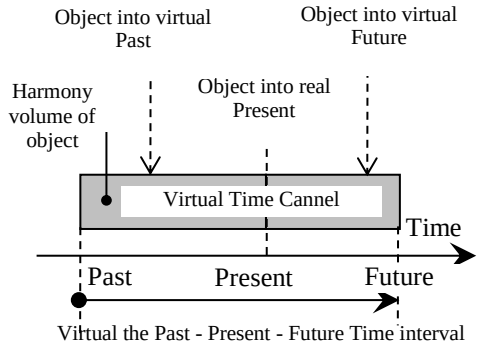

Fig. 10. The scheme of a phenomenon dividing into the Past, Present and Future and its Virtual Time Cannel

2. Class 2 (Mechanics/Natural selection) has real mutual relations comparable to internal and external ones at the point of the Present and is supplemented by virtual relations with the Past, which

constitute structure of the phenomenon (a copy of the Past in the Present of the phenomenon). Mechanics inherits and enhances Thermodynamics.

3. Class 3 (Life/Intelligence) inherits Thermodynamics and Mechanics and is supplemented by virtual relations with the Future (the forecast of a phenomenon) by predicting the development of a phenomena over a certain time interval.
4. Class 4 (the Highest Reason) inherits Thermodynamics, Mechanics and Life and is supplemented by real relations along the entire axis of Time.

The previous and following Classes are cosmological and are beyond the scope of this topic. Thus, Classes 2-4 are directly related to Intelligence, have formalisms, definitions, properties, and are concretized into the following subclasses. Class 2 has conditionally got into this group due to the importance of natural selection for living phenomena.

Virtual Time Channel, Basic Dependencies and Characteristic Values of Classes

Intelligence consistently forms and develops a Virtual Channel in Time (VTC), which fundamentally differs from the channel considered by the Shannon-Hartley theorem in space and provides additional internal Time commutation of phenomena, creating a harmonious superiority of the upper Classes over the lower Classes (Fig. 10).

VTC is a key attribute of Intelligence in contrast with purely logical phenomena.

VTC radically changes the interaction of phenomena (Fig. 11). Thermodynamic phenomena scarcely effect external relations and let them pass with small changes. Mechanical and living phenomena strongly affect external relations with an increase in VTC, turn from passive to active and destabilizing. The Universe is completely self-determined and depends only on internal relations.

VTC radically changes the characteristic value (function) of phenomena from passive entropy, which tends to from complex conditions to simplest ones, and conservative energy, which preserves phenomena, to active harmony that assembles from the simplest to higher conditions and thereby creates complex creative phenomena (Fig. 12).

Table 1. Universal harmonic classification of phenomena

Class	Name	Internal structure	Harmonious Resource	Harmony Type	Characteristic quantity
1	Quasi-chaos (Thermodynamics)	No	Real relations in the Present	Starting	Entropy
2	Natural selection (Mechanics)	Present	+ virtual relations during the interval in the Past	Passive	Energy
3	Life (Intelligence)	Copy of STM-Complex	+ virtual relations during the interval in the Future	Active	Harmony
4	The Highest Reason	Real STM-Complex	+ real present on all Time axis	The Highest	Harmony
5	The Harmon	Absolute	Absolute connectedness	Absolute	Harmony
6	Absolute Chaos	No	No relations	No	No

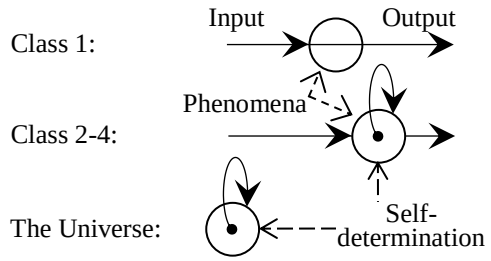

Fig.11. Classification of the phenomena Classes interaction

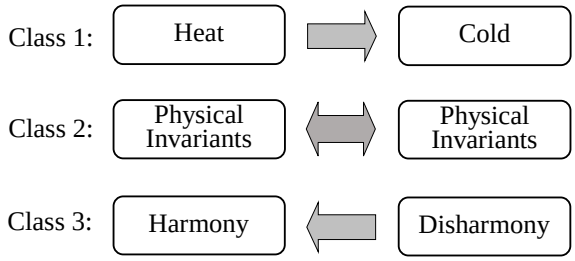

Fig. 12. The scheme of action of characteristic quantities on phenomena Classes

Accordingly, Class 1 destroys, Class 2 preserves, and Class 3 develops phenomea (Table 2).

VTC and additional Time harmony correspond to the negative entropy of E. Schrödinger [14-15].

Table 2. Characteristic quantities of harmonic phenomena classes

Class	Class name	Characteristic quantity	Degree of phenomena harmony
1	Quasi-chaos (Thermodynamics)	Entropy	Degradation
2	Natural selection (Mechanics)	Energy	Conservation
3	Life (Intelligence)	Harmony	Development

Harmony, Meta-Law and Harmon

Cognition is intrinsic to the definition of the Universe and its UA, and therefore he highest Universe's characteristic quantity (that is based on connectedness) is naturally assumed. Let it be called "harmony", the exact formula of which has not yet been obtained, but is qualitatively confirmed everywhere. The original (Meta-) Law of the Universe presupposes its consistent increase (harmonization): all phenomena strive to maximize their harmony. The Meta-Law is the original functionally complete method of harmonization, which provides all the possibilities for the widespread increase in the connectivity of Universe's entities, the particular case of which is cognition.

The limit of harmonization is the condition of complete connectivity (local harmon) - a complete graph built on the components of an entity (harmony), the added arcs of which are the chaos of an entity (Fig. 13).

Definition. Harmony is the coherence of entities.

Definition. Chaos is the lack of coherence of entities.

Consequence. Chaos is a resource for the harmony of entities.

The harmonization limit of the Universe is the state of Harmon as a Complete (C) Infinite (I) Oriented (O) Graph (G) CIOG (CIOG) = lim COGn (COGn), $n \to \infty$, whose vertices are the same graphs (Fig. 14). Harmon is the central concept of the Universal Theory as an initial and final Universe's entity, the study of which is beyond the scope of this topic.

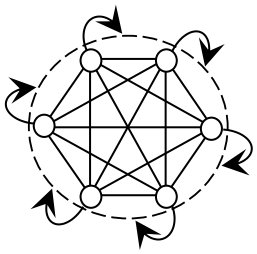

Fig. 14. The Harmon (n = 6), n → ∞

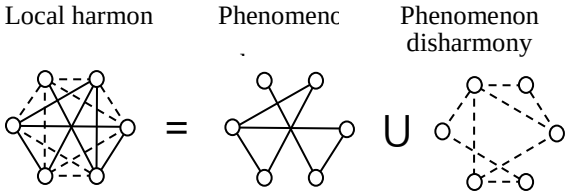

Fig. 13. The scheme of a dichotomy of a phenomenon into harmony (solid lines) and chaos (dotted lines) for n = 6

As a result, two opposite flows of inductive and deductive concepts appear in the subject, which coincide in nature and must coincide in the subject. The coinciding concepts form a subjective system of concepts, and concepts that do not coincide are sent for additional cognition as initiators of new knowledge (Fig. 15).

This scheme corresponds to a conditioned reflex [16] and defines a typical dichotomy of the brain into two hemispheres [17], specializing in induction and deduction, which fundamentally ensures complete cognition, starting with zero cognitive ability of any subject, which any Universe's phenomenon is (Fig. 16).

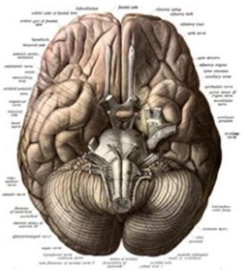

Fig. 16. Typical brain dichotomy

Consequence. Knowledge is subjective.

Consequence. Knowledge is hypothetical.

Definition. A hypothesis is a statement that has not been proven to be false.

Consequence. The elimination of external (from the Universe) and internal (with oneself) knowledge is a necessary method of cognition, since that is the way our Universe is.

Definition. Truth is the Universe.

Consequence. The criterion of truth is the value of externally and internally consistent knowledge.

Consequence. The conditioned reflex provides unlimited cognition of the Universe, starting from zero cognitive ability.

The conditioned reflex and elimination of contradictions substantiate the method of sequential concretization of hypotheses by introducing additional corresponding hypothetical concepts with the distance between them that can be supposedly overcome. These concepts are subsequently verified by facts, which are the subjective reflection of RW. The volume of such a system of concepts remains the only criterion for truth of the formalism (Fig. 17).

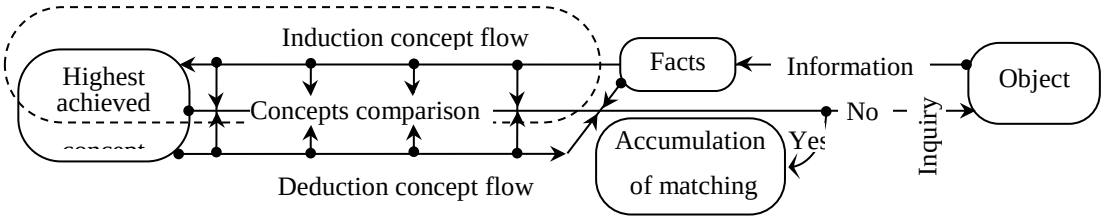

Fig. 15. The scheme of a conditioned reflex

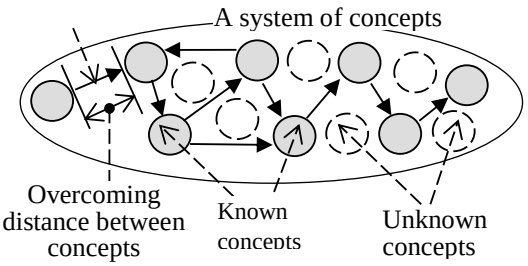

Fig. 17. The scheme of a concepts sequential concretization method

Universal Meta-Definition of Intelligence

The Universe has 3 main divisions: 1) AW and RW, 2) Time (Past, Present and Future) and 3) categories as limiting harmonization, which can be overcome solely under the influence of the Meta-Law through virtualization using the above-mentioned means of harmonization that make up the initial formalism (definition)) of the

UMFI as an important tool of the Universe, further developed by the Highest Reason (Fig. 18).

Definition. Intelligence is an active universal harmonizer of the Abstract, Temporal and Categorical divisions of the Universe.

UMFI is ontologically comprised of all the previously mentioned properties and mechanisms of action, implying further concretization and materialization to various RW conditions.

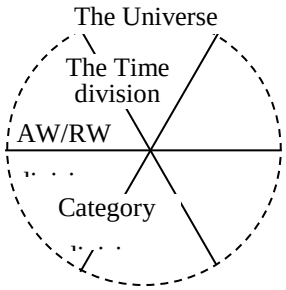

Fig. 18. Illustration of the Universe main divisions

Concretization and Materialization of Intelligence

The UA is directly included in the definition of Intelligence, which is subsequently concretized, presumably, in all places of the Universe through an infinite hierarchy of ecological niches of existence (ENE) with different categorical systems up to materialization at the lowest real level of abstract hierarchy.

Correspondingly, UMFI receives multiple additional concretizations up to and including materialization, which are represented as various low-level formalisms that are gradually becoming more complicated up to the achievement of the status of phenomena that makes it possible to cognize the entire Universe (Fig. 19).

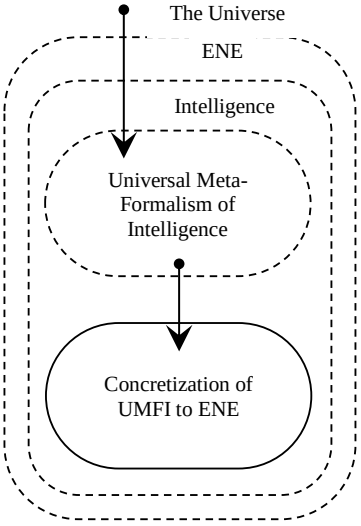

Fig. 19. Intelligence concretization scheme

Discussion

Due to the origin of the Intelligence ontology and the UA Universe, UMFI has the widest application with a long diverse concretization that conceals the common origin of the living world and requires additional explanation.

The first scientific concepts of the Universe and the Intelligence (Life) date back to ancient times (for instance, the dialogue of Socrates about the death) [19-20]. Furthermore, Darwin's hypotheses of the origin of species [21] compared to fundamental, but insufficient scholastic works of scholars should also be mentioned [22-24]. Darwinism is reinforced by L. Gumilev's hypotheses of the formation of ethnic groups in Europe [25-28].

The most exceptional work [29], which has indicated the fundamental limitation of dogmatism for complete cognition, is

confirmed by incomplete attempts to create unifying dogmatic theories [30].

As a result, examination of complex phenomena usually switches to the field of conceptual qualitative philosophy [31-33], which are relevant in social phenomena, but cannot be applied to precise formal machines. UT fully combines all studies into the single UMF and the UMFI that derives from it.

Conclusion

Thus, universalization opens up the possibility of creating a formal scientific theory of Intelligence, which strictly legitimizes research in this area, as well as science that is a product of exclusively intellectual activity.

Within the framework of the Universal Theory, the definition and the Universal meta-formalism of Intelligence have been derived, represented as a structural form and allowing an exact set-theoretic formalization that makes formal processing possible.

The substantiation of all the concepts have been given special attention. The results of the study are pioneering in this area and have an important general scientific value. These results can be applied to various technical and humanitarian research and innovation.

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